

## CLAIMS

What is claimed is:

1. A method of controlling transmit powers at a plurality of base stations during a soft handoff to reduce power imbalance between base stations, the method comprising:
  - receiving power control commands at the base stations from a mobile station in soft handoff;
  - adjusting the transmit powers at the respective base stations responsive to the power control commands from the mobile station by applying power adjustments to current transmit powers of the base stations;
  - varying a step size of the power adjustments as a function of the current transmit powers and a common reference power; and
  - adjusting the common reference power based on power measurement reports from the mobile station.
2. The method of claim 1, wherein varying a step size of the power adjustments as a function of the current transmit powers and a common reference power comprises varying the step size of the power adjustment at each base station based on a difference between the current transmit power of the base station and the common reference power.
3. The method of claim 2, wherein varying the step size of the power adjustment at each base station based on a difference between the current transmit power of the base station and the common reference power comprises:
  - increasing the step size if the power control commands from the mobile station move the transmit power of the base station toward the common reference power; and

decreasing the step size if the power control commands from the mobile station  
move the transmit power of the base station away from the common  
reference power.

4. The method of claim 3, wherein increasing the step size comprises changing the  
transmit power by an adjustment term formed as a sum of a fixed adjustment term and a  
variable adjustment term.

5. The method of claim 3, wherein decreasing the step size comprises changing the  
transmit power by an adjustment term formed as a difference of a fixed adjustment term  
and a variable adjustment term.

6. The method of claim 2, wherein varying the step size of the power adjustment at  
each base station based on a difference between the current transmit power of the base  
station and the common reference power comprises calculating the step size based on a  
fixed adjustment term dependent on the power control commands from the mobile  
station and a variable adjustment term proportional to the difference between the current  
transmit power of the base station and the common reference power.

7. The method of claim 6, wherein calculating the step size comprises:  
selecting one of a fixed upward adjustment value and a fixed downward  
adjustment value as the fixed adjustment term based on the power  
control commands from the mobile station; and  
calculating the variable adjustment term by subtracting the common reference  
power from the current transmit power of the base station.

8. The method of claim 7, wherein calculating the step size further comprises combining the fixed adjustment term with the variable adjustment term.

9. The method of claim 7, wherein calculating the variable adjustment term by subtracting the common reference power from the current transmit power of the base station further comprises multiplying the variable adjustment term by a convergence coefficient.

10. The method of claim 9, further comprising setting a magnitude of the convergence coefficient to set a sensitivity of the power adjustment to the difference between the current transmit power of the base station and the common reference power.

11. The method of claim 1, wherein adjusting the common reference power based on reported frame errors at the mobile station comprises adjusting the common reference power upward if the mobile station sends a frame error report.

12. The method of claim 11, wherein adjusting the common reference power based on reported frame errors at the mobile station further comprises:

receiving an error report from the mobile station at a base station controller communicatively couple to the base stations; and signaling the base stations such that the common reference power is adjusted upward by a predetermined increment value.

13. The method of claim 12, wherein adjusting the common reference power based on reported frame errors at the mobile station further comprises signaling the base

stations such that the common reference power is adjusted downward by a predetermined decrement value if no error report is received from the mobile station within a defined period.

5 14. The method of claim 13, wherein the predetermined decrement value is a relatively small fraction of the predetermined increment value.

15. The method of claim 13, wherein the defined period defines an adjustment rate for the common reference power that is slower than a rate at which the power control  
10 commands are received from the mobile station at the base stations.

16. The method of claim 13, wherein the adjustment rate is a frame rate of forward link data frames defined for forward link signaling between the base stations and the mobile station.

15 17. The method of claim 16, wherein the power control commands from the mobile station are received at the base stations at sixteen times the frame rate.

18. The method of claim 1 wherein the power measurement report from the mobile  
20 station includes the number of error frames since the last power measurement report.

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19. A wireless communication network comprising:  
a plurality of base stations for communicating with a mobile station during soft  
handoff, said base stations each including at least one processor  
programmed to:  
adjust a transmit power of the base station responsive to a power control  
command from the mobile station by applying a power adjustment  
to a current transmit power of the base station; and  
vary a step size of the power adjustment as a function of the current  
transmit power and a common reference power; and  
a base station controller coupled to the base stations, said base station controller  
including at least one processor programmed to adjust the common  
reference power based on power measurement report from the mobile  
station.

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20. The wireless communication network of claim 19, wherein the at least one  
processor in each base station varies the step size of the power adjustment in proportion  
to a difference between the current transmit power of the base station and the common  
reference power.

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21. The wireless communication network of claim 20, wherein the at least one  
processor in each base station increases the step size of the power adjustment if the  
power control command from the mobile station would move the transmit power toward  
the common reference power.

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22. The wireless communication network of claim 21, wherein the at least one processor in each base station decreases the step size if the power control command from the mobile station would move the transmit power away from the common reference power.

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23. The wireless communication network of claim 22, wherein the at least one processor in each base station decreases the step size by computing the step size as a difference between a fixed adjustment term and a variable adjustment term.

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24. The wireless communication network of claim 23, wherein the at least one processor in each base station increases the step size of the power adjustment by computing the step size as a sum of the fixed adjustment term and the variable adjustment term.

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25. The wireless communication network of claim 24, wherein the at least one processor in each base station selects one of a fixed upward adjustment value and a fixed downward adjustment value as the fixed adjustment term based on the power control command from the mobile station.

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26. The wireless communication network of claim 24, wherein the at least one processor in each base station calculates the variable adjustment term as the difference between the common reference power and the current transmit power.

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27. The wireless communication network of claim 26, wherein the at least one processor in each base station calculates the difference between the common reference

power and the current transmit power by subtracting the common reference power from the current transmit power.

28. The wireless communication network of claim 27, wherein the at least one processor in each base station further calculates the variable adjustment term based on scaling the variable adjustment term by a convergence coefficient to set a sensitivity of step size adjustment to the difference between the common reference power and the current transmit power.

29. The wireless communication network of claim 19, wherein the at least one processor in the base station controller adjusts the common reference power based on reported errors at the mobile station by:

receiving an error report from the mobile station; and

signaling the base stations such that the common reference power is adjusted upward by a predetermined increment value.

30. The wireless communication network of claim 29, wherein the at least one processor in the base station controller further adjusts the common reference power by signaling the base stations such that the common reference power is adjusted downward by a predetermined decrement value if no error report is received from the mobile station within a defined reporting period.

31. The wireless communication network of claim 30, wherein the defined reporting period defines an adjustment rate that is slower than a rate at which the power control commands are received from the mobile station at the base stations.

32. The wireless communication network of claim 31, wherein the adjustment rate is a frame rate of forward link data frames defined for forward link signaling between the base stations and the mobile station.

5 33. The wireless communication network of claim 32, wherein the power control commands from the mobile station are received at the base stations at sixteen times the frame rate.

10 34. The wireless communication network of claim 32, wherein the at least one processor in the base station controller maintains an frame timer for timing adjustments to the common reference power.

15 35. The wireless communication system of claim 19 wherein the power measurement report from the mobile station includes the number of error frames since the last power measurement report.



36. A method for controlling a common reference power used by a plurality of base stations during a soft handoff to vary step size of forward link transmit power adjustments, said method comprising:

5 receiving power measurement reports from a mobile station in soft handoff; and  
adjusting the common reference power responsive to the power measurement reports from the mobile station.

37. The method of claim 36 wherein adjusting the common reference power  
10 comprises increasing the common reference power responsive to the receipt of a power measurement report from the mobile station.

38. The method of claim 37 further comprising decreasing the common reference power if no power measurement report is received within a predetermined time period.

15 39. The method of claim 38 wherein decreasing the common reference power comprises decrementing the common reference power by a defined downward amount.

40. The method of claim 39, wherein increasing the common reference power  
20 comprises incrementing the common reference power by a defined upward amount, and wherein the defined downward amount is a fraction of the defined upward amount.

41. The method of claim 36, wherein adjusting the common reference power  
comprises:

25 maintaining an interval timer for timing an update interval;

determining whether a power measurement report is received within the update interval; and  
 incrementing the common reference power if a power measurement report was received during the interval, and decrementing the common reference power if a power measurement report was not received during the interval.

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42. The method of claim 39, wherein maintaining an interval timer comprises maintaining a communication frame timer at a base station controller controlling adjustments of the common reference power.

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43. The method of claim 36 wherein the power measurement report from the mobile station includes the number of error frames since the last power measurement report.

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44. A base station controller for controlling a common reference power used by a plurality of base stations during a soft handoff to vary step size of forward link transmit power adjustments, the base station controller comprising:

- 5        an interface connecting the base station controller to the plurality of base stations; and
- a processor connected to the interface programmed to adjust the common reference power responsive to power measurement reports from the mobile station received via the interface.

10       45. The base station controller of claim 44 wherein the processor increases the common reference power responsive to the receipt of a power measurement report from the mobile station.

15       46. The base station controller of claim 45 wherein the processor decreases the common reference power if no power measurement report is received from the mobile station in a predetermined time period.

20       47. The base station controller of claim 47 wherein the power measurement report includes the number of error frames since the last power measurement report.

48. A processor for controlling a common reference power used by a plurality of base stations during a soft handoff to vary step size of forward link transmit power adjustments, said processor programmed to adjust the common reference power responsive to power measurement reports from the mobile station.

49. The processor of claim 48 wherein the processor increases the common reference power responsive to the receipt of a power measurement report from the mobile station.

50. The processor of claim 49 wherein the processor is further programmed to decrease the common reference power if no power measurement report is received from the mobile station in a predetermined time period.

51. The processor of claim 48 wherein the power measurement report from the mobile station includes the number of error frames since the last power measurement report.